REMARKS

Amendments to the Claims

Claim 1 has been amended without prejudice to recite preferred embodiments of applicants invention which are more clearly differentiated from the prior art and to establish firmer antecedent basis for dependent claims.

Amended claim 1 now specifies that the subject matter is directed to an enzymatic rearrangement process for randomizing fatty acid residues on a triglyceride fat (page 1, lines 4-7) over the terminal and middle positions (page 6, lines 30-33). The process comprising exposing the triglyceride fat in a reaction mixture [the term "reaction mixture" appears 14 times in the specification and means the mixture which is in contact with the lipase catalyst during the rearrangement reaction, e.g., page 31, lines 11-12, which has a water content of 0.001 to 0.1 wt% (original claim 9 and page 11, lines 2-6) to a *Thermomyces languginosas* lipase having an activity of at least 250 IUN at the onset of the process, wherein the process proceeds to a conversion degree on the terminal positions, Re, ranging from 0.3-0.95, and wherein a conversion degree on the middle position, Ra, ranges from 0.06-0.75, and wherein Ra is greater than 0.32Re - 0.08 (original claim 1).

Claims 2-10 have been amended to correct informalities in their preambles, namely "Process" has been replaced by "The process".

Claims 2-5 and 7-10 have been further amended to remove multiple ranges recited in the same claim so as to make the claims clear and unambiguous.

Claim 4 has been reworded to establish proper antecedent basis flowing from claim 1, namely, that the amount of catalyst used when the exposure step of the process recited in claim 1 is carried out in a batch reactor is 0.05 - 9 wt.%.

Claim 5 has been reworded so as to establish proper antecedent basis flowing from claim 1, namely, that the exposure step of the process recited in claim 1 is carried out by passing the reaction mixture through a packed catalyst bed reactor and wherein in the first hour of passage of the reaction mixture through the packed catalyst bed reactor, the reaction mixture has a residence time in the packed catalyst bed reactor of less than 25 min.

Claim 10 has been reworded to establish proper antecedent basis flowing from claim 1, namely, that the reaction mixture has a temperature from 40 to 85°C,.

Claims 11-16 are hereby cancelled without prejudice.

Claims 17 – 22 which depend from claim 1 are new.

Claim 17 specifies that the catalyst has an activity of at least 350 IUN (original claim 2).

Claim 18 specifies that Ra is greater than 0.32Re - 0.04 (original claim 3).

Claim 19 specifies that the amount of catalyst used when the process is carried out in a batch reactor is 0.05 - 3 wt.% calculated on the reaction mixture (original claim 4).

Claim 20 specifies that the exposure step in the process recited in claim 1 is carried out by passing the reaction mixture through a packed catalyst bed reactor and wherein in the first hour of passage of the reaction mixture through the packed catalyst bed reactor, the reaction mixture has a residence time in the packed catalyst bed reactor of less than 15 min (original claim 5).

Claim 21 specifies that the conversion degree Re is at least 0.4 and less than 0.85 (original claim 8 combined with original claim 7).

Claim 22 specifies that the reaction mixture has a temperature of from 50 to 75°C (original claim 10).

Claim Objections

Applicants agent believes that all the informalities pointed out by the Examiner have either been corrected or the claims cancelled (claims 2-10, recitation of "The process"; claims 11-16 canceled).

Claim Rejection 35 USC §112

Amended claims 2-5 and 7-10 now recite a single range for each parameter making their metes and bounds clear and definite.

Claim 11-15 have been canceled rendering moot their rejection under 35 USC §112, second paragraph.

Applicants' submit that amended claims 4 and 5 have clear and unambiguous antecedent basis flowing from claim 1.

In view of the above amendments and remarks, applicants' respectfully request that the §112 rejection be reconsidered and withdrawn.

Claim Rejection 35 USC §101

Claim 15 has been canceled rendering moot its rejection under 35 USC §101.

Claim Rejection 35 USC §103

Claims 1-4 and 6-16 were rejected under 35 USC §103(a) as being unpatentable over Lee et al (US 2003/0054509 – hereinafter "Lee") in light of Sullivan et al (US 5,391,383 – hereinafter "Sullivan") and Zhang et al (JAOCS 2001 78(1): pp57-64 – hereinafter "Zhang"). Applicants respectfully traverse this rejection.

Statement of Facts

Lee is directed to improving productivity of an enzymatic method for producing transesterified fats. Lee teaches that the productivity of enzymatic transesterification or esterification can be greatly improved by purifying the substrate oil to extend the useful life of the enzyme. One example of the purification medium is packed silica gel. (abstract)

Lee discloses *Thermomyces languginosas* as one among a list of 37 microorganisms from which a lipases useful in the invention can be derived (page 3, [0035]). The list includes both Sn1 and Sn3 specific lipases, (e.g., *Thermomyces languginosas* – page 1, [0008]) and non-specific lipases.

The method Lee utilizes for monitoring enzymatic activity is the measurement of one or more physical properties of the fats or oils after having contacted the lipase (page 6, [0062]). Lee is silent about enzyme activity in either "IUN" units or in g/g*h units which are both based on direct chemical conversion.

Lee teaches "that the initial substrate can be composed of one type of glyceride fat or oil and have its *physical properties modified* in a process known as randomization. For example, when fully hydrogenated palm kernel oil is treated with lipase capable of randomization, the components of the product have different physical properties. Both 1,3-selective lipases and nonselective lipases such as Candida cylindracae lipase are capable of this randomizing process". page 3, [0034] – emphasis added).

Lee is silent about controlling the extent of randomization at the sn-2 position of a triglyceride utilizing a lipase that is only sn-1 and sn-3 selective. Lee is silent about specifically measuring the extent of randomization *at the sn-2 position* and in fact, Lee is silent about the measurement of degree of conversion by *direct chemical analysis*.

Sullivan was relied upon by the Examiner for teaching that coconut oil is lauric fat (page 5 – Office Action).

The Examiner relied upon Zhang citing page 561, second column, second to last paragraph) for teaching "Lipozyme TL IM is an sn-1-3 specific lipase from *Thermomyces languginosas* with silica granulation... Applicants believe the Examiner meant to have cited page 561 of **Xu et al** ("Production of Structured Lipids in a Packed Bed Reactor with *Thermomyces languginosas* Lipase") for the above teaching because there is no page 561 in Zhang et al and because this teaching appears at the cited location in Xu et al.

Applicants Arguments

Regarding claim 1. Claim 1 is directed to an enzymatic rearrangement process for randomizing fatty acid residues on a triglyceride fat over the terminal and *middle positions*. Applicants' surprisingly found that the exposure of triglyceride fat in a reaction mixture which has a water content of 0.001 to 0.1 wt% to a *Thermomyces languginosas* lipase (which is an sn-1, sn-3 specific lipase), unexpectedly produces significant rearrangement at the sn-2 position even at relatively low extents of conversion, provided that the enzyme has an *activity of at least 250 IUN* at the *onset of the process*. Under these conditions the process produces a degree of conversion on the middle position, Ra, which ranges from 0.06-0.75 when the degree of conversion at the terminal positions, Re, ranges from 0.3-0.95. The process is carried out to so as to achieve a degree of conversion on the middle position, Ra, which is greater than 0.32Re - 0.08. Applicants have found that the fats produced by this process have significantly lower graininess on storage leading to improved organoleptic properties.

Applicants have unexpectedly found that by requiring the initial enzyme activity to be above the threshold value recited, substantial randomization at sn-2 position occurs even when the randomization at the terminal sn-1, sn-3 positions is incomplete in contrast to the teachings of the prior art (page 26, lines 15-22 and page 3, line 30 to page 5, line 6).

Even more surprisingly is the observation that sn-2 randomisation (Ra) does not change when the enzyme catalyst with high starting activity, according to the invention, was as a consequence of the ongoing process, functioning at a reduced activity. (Example 10 conclusions on page 34, lines 13-19),

Applicants' submit that the combination of Lee, Sullivan and Xu does not teach or suggest all the limitations recited in instant claim 1, because the combination does not teach an enzymatic rearrangement process utilizing *Thermomyces languginosas* lipase which: i) specifically requires that the activity in IUN units to be *at least 250 IUN* at the *onset of the process*; which ii)produces a conversion degree on the middle position, Ra, which ranges from *0.06-0.75* which is greater than *0.32Re - 0.08* when the degree of conversion on the terminal positions, Re, is in the range from 0.3-0.95.

The Examiner concluded from the teaching of Zhang (actually Xu et al) that Lipozyme TL IM is an sn-1,3 specific lipase and consequently that the randomization performed by Lee occurs over the terminal and middle positions of the fatty acid residues on the glyceride moiety. Applicants submit this conclusion is not supported by the facts presented above.

The "randomization" to which Lee refers is the modification of the *physical properties* by treatment with lipase (page 3 [0034]). According to Lee, when fully hydrogenated palm kernel oil is treated with lipase capable of randomization, the components of the product have different physical properties. Both 1,3-selective lipases and nonselective lipases such as Candida cylindracae lipase are capable of this randomizing process".

Applicants submit that what Lee teaches in the above passage is that changes in physical properties can be produced *either* by enzymes that selectively randomize sn-1 and sn-3 fatty acids (such as *Thermomyces languginosas* lipase) or by enzymes that only affect sn-1 and sn-2 , likes Lipozyme TL IM or by enzymes that are non-selective such as Candida cylindracae lipase. Lee does not teach that enzymes which selectively randomize sn-1 and sn-3 fatty acids can effect significant randomization at the sn-2 position at relatively low extents of conversion by selecting an enzyme activity that is above a threshold value because Lee is completely silent about the extent of sn-2 randomization.

The measurement used by Li to detect "randomization" is a change in "Mettler dropping point" which is defined as the temperature at which the mixture of fats becomes fluid (page 6, [0064]). This method can not differentiate between conversions of sn-2 fatty acids from conversions at the sn-1 or sn-3 fatty acids. Furthermore, conversions of saturated fatty acid to unsaturated fatty acid only at the sn-1 and sn-3 positions can lead to dramatic drops in melting point even when no conversion takes place at sn-2. For example, the melting point of 1,2 dioleoyl-3-stearin is 14-15°C compared to a melting point of 71°C for tristearin (see references attached).

The Examiner admitted that Lee does not teach that the Lipase must have an *activity of at least 250 IUN* at the *onset of the process*. However, the Examiner asserted that because Lee teaches that the various parameters such as temperature, flow rate, light, moisture content and residence time can be adjusted to *optimize enzyme activity*, these various parameters can be manipulated through routine experimentation making it obvious to optimize lipase enzyme activity to achieve the conversion degrees Re and Ra recited in applicants' claims. Applicants' respectfully disagree.

Firstly, the enzyme activity at the start of the process to which claim 1 refers is a property of the catalyst itself and is related to the amount of active enzyme molecules per gram of catalyst under a standard set of conditions. Lee is silent regarding this parameter.

Secondly, Lee is silent regarding the entire subject of controlling the extent of randomization at the sn-2 position of a triglyceride utilizing a lipase that is sn-1 and sn-3 selective. Lee is also silent about specifically measuring the extent of randomization at the sn-2 position or in fact, the measurement of degree of conversion by direct chemical analysis. Finally, Lee is silent regarding specific enzyme activity as expressed either by "IUN" units or in g/g*h units which are both based on direct chemical conversion.

MPEP 2144.05 states that a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977) (CCPA 1980).

Neither Lee nor any of the cited references recognizes that initial enzyme activity (the specific activity of the enzyme catalyst as construed in applicants' specification) is a results-effective variable governing the extent of conversion of the sn-2 position, Ra.

Therefore, applicants' submit that it is only through hindsight using applicant's disclosure as a template that applicants limitations on initial enzyme activity to achieve Ra of a particular value could be considered routine optimization of the teachings of Lee, since Lee neither teaches nor suggests the "results-effective variable" nor the "recognized result" as required by MPEP 2144.05.

Lee is directed to the problem of prolonging the enzyme activity of lipases during transesterification. This is a very different problem from applicants' invention which concerns providing an enzyme process that produces appreciable rearrangement on the middle position of a triglyceride fat. Absent a teaching or suggestion of an enzymatic rearrangement process utilizing *Thermomyces languginosas* lipase which includes the limitations on specific enzyme activity in IUN units of *at least 250 IUN* at the *onset of the process* and produces a recited conversion degree on the middle position, Ra, the combination of references does not present a *prima facie* case of obviousness over claim 1.

Regarding claims 2, 3, 17, 18, 20 and 21. Claims 2, 3, 17, 18, 20 and 21 are even further removed from the teachings of Lee, Sullivan and Zhang (actually Xu) because the claims recite even more limited ranges for either specific enzyme activity, degree of conversion of middle position fatty acids (Ra) or degree of conversion of terminal fatty acids, Re.

In view of the above amendments and remarks, applicants respectfully request that the 103(a) rejection over Lee, Sullivan and Zhang be reconsidered and withdrawn.

Claims 1-16 were rejected under 35 USC §103(a) as being unpatentable over Lee et al (US 2003/0054509 – hereinafter "Lee") in light of Sullivan et al (US 5,391,383 – hereinafter "Sullivan") and Zhang et al (JAOCS 2001 78(1): pp57-64 – hereinafter "Zhang") and further in view of Xu et al (JAOCS, 2002, Vol 79(6), 565-565 – hereinafter "Xu"). Applicants respectfully traverse this rejection.

Statement of Facts

Lee, Zhang (Xu) and Sullivan were already discussed.

Xu was relied upon by the Examiner for disclosing that various fat products can be obtained by the lipase-catalyzed modification of oils and fats. Xu teaches that oil was sent through a packed bed reactor of Lipozyme TL 1M and at various flow rates (residence times) to determine their effect on the degree of reaction and the product. Residence times that were tested ranged from about 5 to about 150 minutes.

Xu like Lee teaches that "Lipozyme TL IM is an sn-1-3 specific lipase from *Thermomyces languginosas* with silica granulation... (page 561, second column, second to last paragraph).

Xu, like Lee, is silent regarding controlling the extent of randomization at the sn-2 position of a triglyceride utilizing a lipase that is sn-1 and sn-3 selective. In fact, Table 1 of Xu indicated that under the conditions in which the experiments were carried out, the sn-2 position of the enzyme treated blend was similar to the starting blend.

Xu like Lee is silent regarding any effect which the specific activity of the enzyme at the beginning of the process (I.e., the initial enzyme activity) has on randomization of the Sn-1 fatty acids and in fact does not disclose what the specific activity of the Lipase actually was.

Applicants' arguments

Regarding Claim 1, applicants' submit that the combination of Lee, Sullivan, Zhang and Xu does not teach or suggest all the limitations recited in instant claim 1, because the combination does not teach an enzymatic rearrangement process utilizing *Thermomyces languginosas* lipase which: i) specifically requires that the activity in IUN units to be at least *at least 250 IUN* at the *onset of the process*; which ii) produces a conversion degree on the middle position, Ra, which ranges from *0.06-0.75* which is greater than *0.32Re - 0.08* when the degree of conversion on the terminal positions, Re, is in the range from 0.3-0.95.

Applicants reiterate that the enzyme activity at the start of the process to which claim 1 refers is a property of the catalyst itself and is related to the amount of active enzyme molecules per gram of catalyst under standard conditions. The combination of references especially Lee and Xu teach that variables such as flow rates, temperature, and residence time can affect the degree of overall reaction, the formation of DAG

(diacylglycerides) and free fatty acids (Xu Figure 1). However, these variables are extrinsic, in contrast to the initial enzyme activity recited in claim 1 which is an intrinsic property of the catalyst being used.

The combination of references is silent regarding the entire subject of controlling the extent of randomization at the sn-2 position of a triglyceride utilizing a lipase that is sn-1 and sn-3 selective let alone control of Ra when randomization at sn-1 and sn-3 is incomplete (Re<< 100%). The combination of references are silent about any connection between the extent of randomization at the sn-2 position and the specific enzyme activity as expressed either by "IUN" units or in g/g*h units.

Applicants reiterate that MPEP 2144.05 expressly states that a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977) (CCPA 1980).

Thus, the combination of references does not recognize that initial enzyme activity (the specific activity of the enzyme catalyst as construed in applicants' specification) is a results-effective variable governing the extent of conversion of the sn-2 position, Ra.

Therefore, applicants' submit that it is only through hindsight that applicants limitations on threshold enzyme activity to achieve a particular degree of randomization at sn-2 (Ra) could be considered routine optimization of the teachings of Lee, Zhang,

Sullivan and Xu since these references neither teach or suggest the "results-effective variable" nor the "recognized result" as required by MPEP 2144.05.

Absent a teaching or suggestion of an enzymatic rearrangement process utilizing *Thermomyces languginosas* lipase which includes the limitations on specific enzyme activity in IUN units of *at least 250 IUN* at the *onset of the process* that produces the recited conversion degree on the middle position, Ra, the combination of references does not present a *prima facie* case of obviousness over claim 1.

Claims 2, 3, 17, 18, 20 and 21 are even further removed from the teachings of Lee, Sullivan, Zhang and Xu because the claims recite even more limited ranges for either specific enzyme activity, degree of conversion of middle position fatty acids (Ra) or degree of conversion of terminal fatty acids, Re.

In view of the above amendments and remarks, applicants respectfully request that the 103(a) rejection over Lee, Sullivan, Zhang and Xu be reconsidered and withdrawn and that the application be allowed to issue.

Attorney Docket No.: F7761(V)
Serial No.: 10/587,477
Filing Date: July 26, 2006
Confirmation No.: 5194

If a telephone conversation would be of assistance in advancing prosecution of the subject application, applicants' undersigned agent invites the Examiner to telephone him at the number provided.

Respectfully submitted,

/ Michael P. Aronson /

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Registration No. 50,372
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Answer 1:

Bibliographic Information

Total synthesis of triglycerides of soybean oil. Serebrennikov, G. A.; Mitrofanov, T. K.; Kraevski, A. A.; Sarychev, I. K.; Preobrazhenski, N. A. M. V. Lomonosov Inst. Fine Chem. Technol., Moscow, Doklady Akademii Nauk SSSR (1966), 140 1083-6. CODEN: DANKAS ISSN: 0002-3264. Journal language unavailable. CAN 56:61018 AN 1962:61018 CAPLUS

Abstract

cf. CA 55, 12308e. The following triglycerides were synthesized by the usual route, starting from isopropylideneglycerol: α-linolenoylβ,α-distearin, m. 24.3-4.5°; α-linoleoyl-β,α-distearin, m. 36-8°; α-linoleoyl-β,α'-dipalmitin, m. 36.5-8.0°; α-palmitoyl-βα'-dilinolein, m. -4 to -3° d20 (0.9141, n20D 1.4729; α-oleyl-β-stearoyl-α'-linolein, m. -20 to -19° and -62 to -16.5° 0.9082, 1.4665; α,α'-dioleoyl-β stearin, m. 14-15° and 39.5-40.5°; triolein, m. -4° and - 13 to - 12°, 0.9146, 1.4676; α-oleoyl-β,α'-distearin, m. 25-7°; α-stearoyl-β-oleoyl-α'-linolein, m. -4 to -2° and -17 to -15°, 0.9044, 1.4661; α-stearoyl-β-linoleoyl-α'-olein, m. -19 to -18° and -13 to -11.5°, 0.9046, 1.4652; α,α'-distearoyl-β-linolenin m. 19.5-20.5° and 36°; αα'-distearoyl-β-linolein m. 35-6°; αα'-distearoyl-β-olein m. 22-2.5°, 41-2.5°, and 60-1°; α-stearoyl-β,α'-diolein m. 21-1.5°; tristearin m. 62-3°; α-palmitoyl-β,α'-dilinolenin m. - 11 ° to - 10° , 0.9401, 1.4818; α-palmitoyl-β-linolenoyl-α'-linolein m. -14° to -13° and -8° to -7°, 0.9226, 1.4758; tripalmitin m. 64.5 5.5°. Linoleic acid was synthesized as follows (yields, m..p. or b.p., d., n20D given): condensation of BuBr with 1-chloro-2-butyn-4-ol gave 2-octyn-1-ol, -, b16 98 100°, 0.8966, 1.4551, which with PBr3 gave 1-bromo-2-octyne (I) 80.4,%, b5 69-72°, 1.2095, 1.4859. 1,6-Dibromohexane was converted into 1,9-decadiyne, -, b18 76-7°, 0.8376, 1.4532, which with thioacetic acid gave 9-decyn-1-en-1-thiol acetate, 79.3%, b0.12 95.3-6.4°, 0.9746, 1.5022, which was converted into 9-decynal oxime, 88.4%, m. 79.1-9.5°, -, -, which yielded 9-decynal ethylene acetal 67.1%, b16 73-4.5°, 0.9504, 1.4564. This condensed with I gave 9,12-octadecadiynal ethylene acetal, 57.6%, b0.09 142.9-4.1°, 0.9411, 1.4789, which upon hydrolysis and oxidn. gave 9,12-octadecadiynoic acid, 39.7%, m. 42.6-3.9° (Rf in BuOH-CHCl3 25% NH4OH 0.84). Selective hydrogenation gave cis,cis-9,12-octadecadienoic acid, 82.6%, b0.21 148.1-50.7°, 0.9122, 1.4715 (Rf 0.71 in BuOH-10% NH4OH).

Indexing -- Section 41 (Fats and Waxes)

Stomach
(acid or HCl secretion by, chloride transport and elec. activity of mucosa in relation to)

Soybean oil
(glycerides (tri-) in, prepn. of)

Glycerides
(prepn. of, of soybean oil)

Linolenin, 1,3-distearo-2-
Role: PREP (Preparation)

1195652-21-1P
Role: SPN (Synthetic preparation); PRP (Properties); PREP (Preparation)
(Total synthesis of triglycerides of soybean oil.)

60-33-3P, Linoleic acid
122-32-7P, Olein, tri-
555-43-1P, Stearin, tri-

555-44-2P, Palmitin, tri-
1720-38-3P, 1,9-Decadiyne
2012-14-8P, 9,12-Octadecadiynoic acid
2190-13-8P, Linolein, 1,3-distearo-2-
2190-14-9P, Linolein, 2-oleo-3-stearo-1-
2190-15-0P, Linolein, 3-palmito-1,2-di-
2190-15-0P, Palmitin, 2-linoleno-3-linoleo-1-
2190-29-6P, Olein, 2,3-distearo-1-
2410-28-8P, Olein, 3-stearo-1,2-di-
2410-29-9P, Olein, 2-stearo-1,3-di-
2410-30-2P, Stearin, 1-linoleo-3-oleo-2-
2410-30-2P, Linolein, 3-oleo-2-stearo-1-
2410-30-2P, Olein, 3-linoleo-2-stearo-1-
2442-53-7P, Linolein, 2,3-distearo-1-
2442-54-8P, Linolenin, 2,3-distearo-1-
2442-54-8P, Stearin, 3-linoleno-1,2-di-
2535-35-5P, Linolein, 2,3-dipalmito-1-
2846-04-0P, Olein, 1,3-distearo-2-
4353-07-5P, 1,3-Dioxolane, 2-(8-nonynyl)-
6009-34-3P, 1,3-Dioxolane, 2-(8,11-heptadecadiynyl)-
7162-26-7P, Olein, 2-linoleo-3-stearo-1-
7162-26-7P, Linolein, 1-oleo-3-stearo-2-
18495-27-7P, 2-Octyne, 1-bromo-
20739-58-6P, 2-Octyn-1-ol
88286-50-4P, Stearin, 2-linoleno-1,3-di-
90977-82-5P, 9-Decynal, oxime
95769-70-3P, Acetic acid, thio-, S-1-decen-9-ynyl ester
95769-70-3P, 1-Decen-9-yne-1-thiol, acetate
97919-02-3P, Linolein, 2-linoleno-3-palmito-1-
106800-94-6P, Linolenin, 3-palmito-1,2-di-
Role: PREP (Preparation)
(prepn. of)

642-35-3, Oxytocin, 3-(phenylalanine)
(vasotocin effect on salt and water in urine of frog in response to)

Research Topic task started on Thu Jun 3, 2010 at 12:44 PM

2 Research Topic candidates were identified in CAPLUS and MEDLINE.

using the phrase "melting point stearoyl diolein"

Selected 1 of 2 candidate topics.

4 references were found containing all of the concepts **"melting point"**, **"stearoyl"** and **"diolein"**.

Connected to ChemPort: document

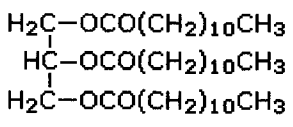
* Zhong, Nanjing, Li, Lin, Xu, Xuebing, Cheong, Lingzhi, Li, Bing, Hu, Songqing, Zhao, Xihong. An Efficient Binary Solvent Mixture for Monoacylglycerol Synthesis by Enzymatic Glycerolysis. Journal of the American Oil Chemists' Society (2009), 86 (8), 783-789.

Task History

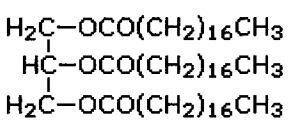
fats and oils. These **triglycerides** (or triacylglycerols) are found in both plants and animals, and compose one of the major food groups of our diet. Triglycerides that are solid or semisolid at room temperature are classified as fats, and occur predominantly in animals. Those triglycerides that are liquid are called oils and originate chiefly in plants, although triglycerides from fish are also largely oils. Some examples of the composition of triglycerides from various sources are given in the following table.

	Saturated Acids (%)					Unsaturated Acids (%)		
Source	C_{10} **& less**	C_{12} **lauric**	C_{14} **myristic**	C_{16} **palmitic**	C_{18} **stearic**	C_{18} **oleic**	C_{18} **linoleic**	C_{18} **unsaturated**
Animal Fats								
butter	15	2	11	30	9	27	4	1
lard	-	-	1	27	15	48	6	2
human fat	-	1	3	25	8	46	10	3
herring oil	-	-	7	12	1	2	20	52
Plant Oils								
coconut	-	50	18	8	2	6	1	-
corn	-	-	1	10	3	50	34	-
olive	-	-	-	7	2	85	5	-
palm	-	-	2	41	5	43	7	-
peanut	-	-	-	8	3	56	26	7
safflower	-	-	-	3	3	19	76	-

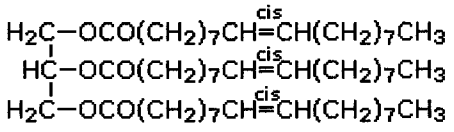
As might be expected from the properties of the fatty acids, fats have a predominance of saturated fatty acids, and oils are composed largely of unsaturated acids. Thus, the melting points of triglycerides reflect their composition, as shown by the following examples. Natural mixed triglycerides have somewhat lower melting points, the melting point of lard being near 30 ° C, whereas olive oil melts near -6 ° C. Since fats are valued over oils by some Northern European and North American populations, vegetable oils are extensively converted to solid triglycerides (e.g. Crisco) by partial hydrogenation of their unsaturated components. Some of the remaining double bonds are isomerized (to trans) in this operation. These saturated and trans-fatty acid glycerides in the diet have been linked to long-term health issues such as atherosclerosis.



trilaurin
mp 45° C



tristearin
mp 71° C



triolein
mp -4° C

Triglycerides having three identical acyl chains, such as tristearin and triolein (above), are called "simple", while those composed of different acyl chains are called "mixed". If the acyl chains at the end hydroxyl groups (1 & 3) of glycerol are different, the center carbon becomes a chiral center and enantiomeric configurations must be recognized.